FAIRING FOR A RISER

The present invention relates to a fairing for mounting upon a cylindrical underwater member such as a marine riser.

In fact the present invention has been developed for use in connection with marine risers used in offshore oil extraction, although it has potential applications in other situations in which a submersed, cylindrical member is exposed to water flow and must be protected from the effects thereof.

Water currents impinging on marine risers create two particular problems. Firstly they create drag, i.e. a lateral loading upon the riser, producing undesirable bending stresses and potentially also increasing loads at the riser's point of suspension. Secondly they can create so-called vortex induced vibration (VIV). Vortices are found to be shed alternately from opposite sides of the riser and the effect can be to produce vibration which is potentially damaging, particularly if resonance effects cause the vibration's amplitude to build up.

It is known to address both problems by placing around the riser a streamlined, teardrop shaped fairing which is free to pivot about the riser's axis and so to "weathervane" - that is, to align itself with the direction of the current. Searches have brought to light several such fairings in the patent literature.

GB 1193750 describes a fairing device for a cable towed behind a ship. A "D" shaped

channel to receive a cable 7 is formed along most of the length of the fairing between a flat front face of a body part and a "u" shaped metal strap bolted to it, so that the fairing surrounds and covers the cable.

US 5722340 (Sweetman) discloses a fairing formed from two identical halves which are assembled together with a riser to form a teardrop shape surrounding and containing the riser.

US 4078605 (Jones) depicts a fairing of teardrop shape having end walls with through-going openings to receive a riser. These openings are set well backward of the fairing's leading edge.

US 4398487 (Ortloff) concerns a fairing which defines an internal channel to receive a riser and has a relatively elaborate spring-loaded bearing arrangement through which it engages with the riser.

US 4474129 (Watkins et al) discloses a riser pipe fairing which splits into two halves along its plane of symmetry, the two halves being assembled around the riser during deployment and riding upon bearing assemblies formed as circular loops, which are slipped through slots in the fairing halves allowing the fairing to rotate relative to the bearing assemblies.

The fairing disclosed in US 6067922 (Denison et al) is not a teardrop shape, but has a generally tubular portion with a planar flange projecting from it. The tube can be opened out to allow it to be placed around a riser and bolts through two halves of the flange secure it in position.

US 4171674 (Hale) is another document concerned with a fairing formed from two halves for assembly around the riser.

GB 2334733 (Reading and Bates Development Co) discloses a fairing whose leading edge is formed by shaped "doors" having part-cylindrical portions which can be opened out to receive a riser and then closed around it to form a roughly cylindrical surrounding the riser.

A successful fairing must address several technical challenges:-

i. It should be capable of being straightforwardly fitted to the riser;

ii. It must be capable of surviving the marine environment and of functioning without causing unacceptable damage to the riser.

iii. It must be capable of reliably weathervaning, since if the fairing becomes fixed in a position transverse to the flow then its effect on both drag and VIV may be positively deleterious;

iv. It should preferably be capable of straightforward and economical manufacture; and

v. It is preferable to minimise drag.

Looking at the above described prior art, complexity of construction is considered to be a problem of several of the fairings, adding to the difficulty and expense of manufacture. It is

also regarded as undesirable that all of these fairings, since they surround the riser, inevitably add somewhat to the frontal area presented to the flow. Increased frontal area creates increased drag. There are also concerns about difficulty of deployment of some of the fairings, particularly where this involves assembly of multiple parts.

The present invention is intended to provide a novel and improved solution to the technical challenges.

In accordance with a first aspect of the present invention there is a fairing for mounting upon a cylindrical member for underwater deployment, the fairing comprising a fairing body which, viewed along its length, is substantially wedge-shaped, having a relatively broad front tapering to a relatively narrow trailing edge, and at least two collars which are both secured to the fairing body and are separated from each other along the length of the fairing body, the collars being positioned and aligned to receive the cylindrical member with the fairing body's front lying adjacent the cylindrical member and the axis of the cylindrical member lying along the length of the fairing body, thereby to pivotally mount the fairing body upon the cylindrical member such that it is able to rotate about the axis of the cylindrical member and so align itself with a water current, the fairing body and the cylindrical member together defining, when viewed along the length of the fairing, a teardrop shape having a leading edge formed, between the collars, by the cylindrical member.

Preferably a portion of each collar is interposed between the fairing body and the cylindrical member in use, providing clearance therebetween.

Each collar is preferably shaped to form a respective bearing ring for receiving the cylindrical member. Each bearing ring preferably has a substantially circular interior surface.

However in a preferred embodiment the bearing ring is split such that it can be opened out to allow the cylindrical member to be inserted into it laterally.

An end portion of the collar may be initially free to allow the bearing ring to be opened out, means being provided to subsequently secure the free end of the collar to the fairing body to retain the fairing upon the cylindrical member.

In a particularly preferred construction the collar comprises two bifurcated portions, one limb of each extending between the cylindrical member and the fairing body to provide clearance therebetween and the other limb of each being secured in use to the fairing body.

The front of the fairing body may be shaped to complement the cylindrical member, its surface(s) lying upon a notional cylinder.

Preferably a bearing surface of the collar, which faces toward the cylindrical member and upon which the collar rides, comprises low friction material. The surface may be self lubricating. It is particularly preferred that the collar comprises a plastics material with an admixture of a friction reducing agent.

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plastics material with an admixture of an anti-fouling agent.

It is particularly preferred that the fairing body and the collar are formed by separate plastics mouldings.

The fairing body is preferably formed as a hollow plastics moulding whose interior communicates with the exterior to permit equalisation of pressure.

In accordance with a second aspect of the present invention there is a fairing for mounting upon a cylindrical member for underwater deployment, the fairing comprising a substantially wedge shaped fairing body which tapers from a front face of the body to its trailing edge, and at least one collar coupled to the fairing body and arranged to receive the cylindrical member and to mount the fairing upon the cylindrical member with the fairing body's front face adjacent the cylindrical member, the collar permitting the fairing to rotate about the cylindrical member and so to align itself with a water current.

Specific embodiments of the present invention will now be described, by way of example only, with reference to the accompanying drawings in which :-

Figure 1 is a perspective illustration of an assembly comprising a first fairing embodying the present invention mounted upon a marine riser;

Figure 2 is a side elevation of the same assembly;

Figure 3 is a section through the assembly at station A-A;

Figure 4 is a section through the assembly at station B-B;

Figure 5 is a perspective illustration of a collar forming part of the fairing;

Figure 6 is a section in a longitudinal plane through an assembly comprising a clamp and a fairing both embodying aspects of the present invention mounted upon a marine riser; and

Figure 7 is a section through the same assembly in a transverse plane; and

Figure 8 is a perspective illustration of a stage in the manufacture of a fairing body embodying the present invention.

The fairing 2 illustrated in Figures 1 to 5 comprises (a) a fairing body 4 and (b) a plurality of collars 6 serving to rotatably couple the fairing body 4 to a cylindrical marine riser 8.

The fairing body 4 can be seen to be generally wedge shaped. Its front, lying adjacent the riser 8, has a lateral dimension similar to that of the riser. In the illustrated embodiment this dimension is slightly smaller than the riser diameter. Moving toward its rear the fairing body tapers to a narrow trailing edge 10. This shape is defined by convergent walls 9, 9^1, which meet at the trailing edge. The front face 12 of the fairing body is shaped to conform to the adjacent surface of the riser, being part cylindrical and concave. The cross section which the assembly of riser and fairing presents to a current of water is best appreciated from Figure 3,

where it can be seen that the assembly's leading edge 14 is formed by the riser itself and that the whole assembly forms a streamlined teardrop shape. In a manner which will be wholly familiar to the skilled person, this shape tends to maintain laminar flow and serves both to reduce drag (i.e. lateral loading upon the riser due to the current) and to prevent or reduce VIV.

The illustrated embodiment has a pair of identically formed collars 6,6' at opposite ends of the fairing body. In Figure 5 it can be seen that each collar comprises a bearing ring 16 which is split at 18 to allow the riser 8 to be introduced laterally into the bearing ring. The collar is formed of a resiliently deformable material so that the ring can be opened out - that is, ends of the ring on either side of the split 18 can be drawn apart - to allow the riser to be introduced. In the present embodiment this deformation of the collar is facilitated by a reduced thickness region 20 which serves as a resilient hinge. At 22,24 the collar has a bifurcated section. One limb 26, 28 leading from each bifurcation forms part of the bearing loop and in use lies between the fairing body and the riser (see Figure 4) while the other limb 30, 32 extends in a direction generally parallel to an adjacent face 34, 36 of the fairing body and forms a mounting tab through which the collar is mounted to the fairing body.

As seen in Figure 3, the fairing body has shallow recesses or pockets in which the mounting tabs are received, so that the tabs' outer surfaces are generally flush with the adjacent faces 34, 36 of the fairing body (see Fig. 3). Attachment of the tabs to the fairing body is achieved using mechanical fasteners received by through-holes 38, 40 in the tabs which align with holes in the fairing body. The fasteners shown in the drawings are formed as nuts and bolts 42. In order to resist corrosion and minimise weight these may be formed of plastics.

However it is anticipated that during refinement of the product some other form of plastics fastener such as a plastics rivet is likely to replace the nuts and bolts. The fairing may be supplied to the end user with the tabs on one face 34 pre-attached so that to mount the fairing the user first inserts the riser into the collars and then secures the relevant tabs to the other face 36.

The fairing body is formed by a single plastics moulding. More specifically the illustrated item is manufactured by the well known technique of rotational moulding, so that it is hollow. Polythene is the preferred material for this component, which is advantageous due to its low specific gravity (similar to that of water), toughness and low cost. An opening 44 allows water to enter the fairing body to equalise internal and external pressures. The body could instead be formed as a solid polyurethane moulding. The collars are each formed by a single plastics moulding but for these the favoured material is nylon, which again has a specific gravity similar to that of water.

It will be apparent that the internal face 44 of the collar's bearing ring 16 serves as one half of a rotary bearing allowing the fairing to rotate about the riser's longitudinal axis and so to weathervane to face a current. Only the collar makes contact with the riser, its portion interposed between the fairing body and the riser serving to maintain clearance between these parts. The present inventor has recognised that it is highly desirable for this bearing surface to be (a) low friction and even "self lubricating" and (b) resistant to marine fouling. These properties can be promoted by incorporation of anti-fouling and friction reducing materials into the material of the collar. In the illustrated embodiment the plastics material of the collar contains an admixture of an anti-fouling composition which provides a controlled rate of

release of copper ions, whose biocidal properties are well known, and also of silicon oil serving to reduce bearing friction.

The internal part of the bearing on which the fairing is mounted may be provided by the riser itself. That is, the fairing may be mounted directly upon the riser (or on a cylindrical protective sheath conventionally provided around the riser). A number of such fairings would normally be placed adjacent one another in a string along the riser. To prevent the fairings from moving along the length of the riser, clamps are secured to it at intervals (typically a string of perhaps five fairings would be confined between a pair of clamps). The clamps may be of a type well known in the context having a pair of half cylindrical clamp shells secured to the riser by a tension band passed around the shells.

An alternative arrangement can be understood from Figures 6 and 7 in which a clamp formed by two half cylindrical clamp shells 50, 52 is secured to the riser, again labelled 8 in this drawing, by a tension band 54 received in a shallow annular recess in the exterior of a central flange 56 formed by the clamp shells from either side of which project reduced diameter spigot portions 58 upon which the collars 60, 62 of respective fairings, arranged on opposite sides of the clamp, ride. The drawing is simplified in that remaining parts of the two fairings are omitted (they can be taken to be similarly formed to those of the previous embodiment). While only a single clamp is shown in the drawing, it is to be understood that in this arrangement a clamp is provided between each adjacent pair of fairings, so that the fairings' rotary bearings are in each case formed by a collar riding upon the clamp.

Trials have shown that the front face 12 of the fairing body can be omitted and that drag can

thereby be reduced. In this case the front edges of the walls 9, 9^1 of the fairing body form its front surface, and may be shaped to conform to the adjacent cylindrical surface of the riser. A convenient way to manufacture this fairing body can be appreciated from Figure 8 there is a single hollow moulding 70 is in the shape of two fairing bodies placed nose-to-nose. By dividing the moulding in the plane 72 and suitably machining/dressing the cut edges, two bodies are formed. Rotational moulding of the structure 70 is favoured. Shallow recesses 74.76 will receive the mounting tabs 30, 30 of the collars.